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IS 13387 (1992): Tool steel forgings for metal forming [MTD 16: Alloy Steels and Forgings]

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Indian Standard

TOOL STEEL FORGINGS FOR METAL FORMING — SPECIFICATION

UDC 669·14 - 134

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 1992 Price Group 3

Steel Forgings Sectional Committee, MTD 18

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Steel Forgings Sectional Committee had been approved by the Metallurgical Engineering Division Council.

The requirements of tool steel forgings were earlier covered in IS 4367 : 1967 'Specification for alloy and tool steel forgings for general industrial use'. Based on the experience gained during these years it was felt necessary to formulate a separate Indian Standard covering detail requirements of tool steel forgings. Subsequently IS 4367 has been revised and published as IS 4367 : 1991 'Alloy steel forgings for general industrial use — Specification (*first revision*)' deleting the requirements of tool steel forgings from it.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 1 NOVEMBER 1994
TO
IS 13387 : 1992 TOOL STEEL FORGINGS FOR METAL FORMING — SPECIFICATION

(*Page* 1, *clause* **2**) — Substitute 'IS 1387 : 1993 General requirements for the supply of metallurgical materials (*second reivison*)' *for* 'IS 1387 : 1967 General requirements for the supply of metallurgical materials (*first revision*)'.

(*Page* 2, *clause* **10.2**, *Note* 1) — Substitute '0.50 percent' *for* '0.05 percent'.

(MTD 18)

Reprography Unit, BIS, New Delhi, India

Indian Standard

TOOL STEEL FORGINGS FOR METAL FORMING — SPECIFICATION

1 SCOPE

1.1 This standard covers the requirements of tool steel forgings for metal forming operations.

2 REFERENCES

IS No.	*Title*
1387 : 1967	General requirements for the supply of metallurgical materials (*first revision*)
1500 : 1983	Method for Brinell hardness test for metallic materials (*second revision*)
1956 (Part 6) : 1976	Forgings (including drop forging) (*first revision*)
6396 : 1983	Method of measuring decarburized depth of steel (*first revision*)
3469 (Parts 1 to 3) : 1974	Tolerances for closed die steel forgings (*first revision*)

3 TERMINOLOGY

3.1 For the purpose of this standard, definitions of forging terms shall be as given in IS 1956 (Part 6) : 1976.

4 SUPPLY OF MATERIAL

4.1 General requirements relating to the supply of tool steel forgings shall conform to IS 1387 : 1967.

5 MANUFACTURE

5.1 Forgings shall be manufactured from steel produced by electric or any other approved process. The steel shall be fully killed. When so desired the purchaser and the supplier may agree to a particular secondary steel refining process to have low hydrogen, oxygen and nitrogen, the maximum content of which may be as agreed to between the purchaser and the manufacturer.

5.2 The steel shall be clean and the forgings shall have minimum directional properties arising from non-metallic inclusions.

5.3 Sufficient reduction by hot working and discard shall be made on each ingot so as to ensure complete soundness, adequately homogenous structure and desired carbide distribution. The forgings shall be free from Hooky structure formed by carbides due to inadequate reduction.

5.4 Long bars of rectangular, square hexagon sections shall be made by hot forging between flat dies. If necessary round sections may be forged in V dies and finished by swaging operation for achieving the dimensions.

5.4.1 Hot forging shall be made in hammer or press of sufficient capacity for adequate working of the core of the raw material during forging.

5.5 In case of cylindrical forgings with short length, cuboidal shaped, disc and ring type forgings, ingot or bloom shall undergo both drawing and upset operation.

5.6 The amount of hot working shall vary with composition of steel resulting uniform carbide distribution in case of high alloy steel.

5.7 Rectangular and square forging die blocks shall be hot worked from 3 axis direction.

5.8 The forgings shall not be burnt or overheated. The finishing temperature and hot working sequence shall be such that results in an adequately uniform grain structure. The cooling from finished forging temperature shall be slow to avoid cracks.

6 HEAT TREATMENT OF FORGINGS

6.1 The forgings shall be supplied in fully annealed and descaled condition. In case of steel susceptible to hydrogen flakes, flake annealing treatment shall be given immediately after forging depending on the method of manufacture and refining treatment given to the steel.

6.2 The forging may be supplied in hardened and tempered condition to the required hardness range specially agreed to between the supplier and the purchaser. Before hardening and tempering the forging shall be rough machined.

7 DECARBURIZATION

7.1 The steel shall be free from ferritic decarburization. The maximum allowable decarburisation shall be 75 percent of the specified minimum machining allowance of the forging prior to heat treatment operations. The measurement of decarburization shall be according to IS 6396 : 1983.

8 FREEDOM FROM DEFECT

8.1 Forgings shall be free from any harmful internal and surface defects as agreed to between the supplier and the purchaser.

9 TOLERANCES

9.1 Tolerances for forgings shall be as specified in IS 3469 (Parts 1 to 3) : 1974 unless otherwise agreed to between the supplier and the purchaser. Forging dimension shall include the machining allowance as given in Table 1 unless otherwise specified by the purchaser.

Table 1 Machining Allowances of Tool Steel Forgings

(*Clause* 9.1)

Ordered Size, mm	Minimum Allowance for Machining Prior to Heat Treatment, mm
Up to 50	2
Over 50 to 75	2·5
Over 75 to 100	3
Over 100 to 125	4
Over 125 to 150	5
Over 150 to 200	6
Over 200	8

9.2 Tolerance on rough machined forgings shall be as agreed to between the supplier and the purchaser.

10 CHEMICAL COMPOSITION

10.1 The ladle analysis of steel, when carried out either by the methods specified in the relevant parts of IS 228 or any other established instrumental/chemical method, shall be as given in Table 2. In case of any dispute, the procedure given in relevant parts of IS 228 shall be the referee method.

10.2 Elements not specified in Table 2 shall not exceed the following limits:

Constituent	*Percent*
Chromium	0·30
Nickel	0·30
Molybdenum	0·05
Copper	0·25
Vanadium	0·05
Tin	0·05
Boron	0·000 3

NOTES

1 Trace elements (Cr+Ni+Mo) when added together shall not exceed 0·05 percent.

2 Percent copper + 10 × (Percent Tin) shall not exceed 0·50 percent.

10.3 When so desired by the purchaser, steel may be supplied in copper bearing quality with copper ranging from 0·25 to 0·35 percent.

10.4 Where necessary, more restricted ranges of chemical composition may be specified subject to mutual agreement between the supplier and the purchaser.

11 HARDNESS

11.1 Tool steel forgings when supplied in annealed condition, the hardness on the annealed forgings shall not exceed 269 HV. The Brinell hardness test where specified, shall be carried out in accordance with IS 1500 : 1983. The care should be taken to remove decarburized layer by machining or grinding before hardness testing. The measurement of hardness on the annealed steel shall be made at arbitrary place of forging. Minimum one hardness test for each heat of each annealed batch shall be taken.

11.2 The locations and the sampling plan for hardness test of quenched and tempered forgings shall be decided by mutual agreement between the supplier and the purchaser.

12 ADDITIONAL TESTS

12.1 Subject to mutual agreement between the supplier and the purchaser the following additional tests may also be specified. In this case prior agreement shall be reached between the purchaser and the supplier on the sampling method, test and acceptance criteria:

Macrostructure examination
Microstructure examination (*see* Annex A)
Non-metallic inclusions examination
Macro streak flaw examination
Magnetic particle examination
Ultrasonic examination

13 CONDITIONS OF SUPPLY

13.1 Forgings may be supplied in any one of the following:

a) Forged and annealed

b) Rough machined after annealing the forging

c) Rough machined after annealing the forging and hardened and tempered

d) Fully machined

14 MARKING

14.1 Unless otherwise agreed between the supplier and the purchaser, each forging shall be clearly marked with the following information:

a) Indication of the source of manufacture,

b) Steel designation,

c) Heat number or identification mark by which it can be traced to cast of steel from which the forging was made, and

d) Dimension.

15 REPORT

15.1 The supplier shall submit to the purchaser the report in which the designation, heat number or alternative identification mark for the heat number, chemical composition, dimension, condition of supply for the forgings are entered.

15.1.1 The material may also be marked with the Standard Mark. Details are available with the Bureau of Indian Standards, New Delhi.

Table 2 Chemical Composition of Tool Steel Forgings for Metal Forging

(*Clause* 10.11)

Designation as per IS 1762 (Part 1) : 1974	Percentage								Application (for Reference only)
	C	Si	Mn	Cr	Ni	Mo	V	W	
Cold Forming									
T158	1·25-1·90	0·10-0·30	0·20-0·35	—	—	—	—	—	Dies for cold drawing
T118Cr2	1·10-1·25	0·10-0·30	0·20-0·35	0·30-0·60	—	—	0·30 *Max*	—	-do-
T103V2	0·95-1·10	0·10-0·30	0·20-0·35	—	—	—	0·15-0·30	—	-do-
T90Mn6Cr2V2W2	0·85-0·95	0·10-0·35	1·25-1·75	0 30-0·60	—	—	0·25 *Max* optional	0·40-0·60	Press die for cold forming
T215Cr48	2·00-2·30	0·10-0·35	0·25-0·50	11 0-13·0	—	0·80 *Max* optional	0·80 *Max* optional	—	Wire drawing die, for press, die for powder, die for thread rolling, cold forging, cold forging roll
T150Cr48Mo10V4	1·40-1·60	0·40 *Max*	0·60 *Max*	11·0-13·0	—	0·80-1·20	0·20-0·50	—	
T210Cr54	1·80-2·40	0·40 *Max*	0·60 *Max*	12·0-15·0	—	—	0·30 *Max*	—	
T100Cr20Mo10V4	0·95-1·05	0·40 *Max*	0·60-0·90	4·5-5·50	—	0·80-1·20	0·20-0·50	—	
Hot Forming									
T37Cr20Si4Mo50V4	0·32-0·42	0·80-1·20	0·50 *Max*	4·50-5·50	—	1·00-1·50	0·30-0·50	—	Dies for press forging, Dies for upsetter, dies for extrusion
T37Cr20Si4Mo50V4	0·32-0·42	0 80-1·20	0·50 *Max*	4·50-5·50	—	1·00-1·50	0·20-0·60	1·00-1·50	
T30Cr10V4W38	0·25-0·35	0·40 *Max*	0·60 *Max*	2·00-3·00	—	—	0·30-0·50	9 00-10·00	
T55Ni8Cr3Mo3V2	0·50-0·60	0·15-0·40	0·65-0·80	0·60-0·80	1·50-1·80	0·25-0·35	0·07-0·12	—	Dies for hot forging in hammer and press
T55Ni8Cr4Mo5V2	0·50-0·60	0·15-0·40	0·65-0·95	1·00-1·20	1·50-1·80	0·45-0·55	0·07-0·12	—	

NOTES

1 Percentage of sulphur and phosphorus unless otherwise agreed to between the purchaser and the supplier shall be 0·03 *Max*.

2 Unless agreed otherwise, level of oxygen shall not exceed 30 PPM.

ANNEX A

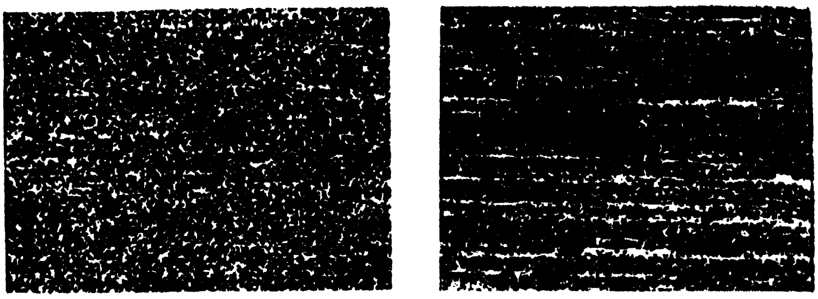
(*Clause* 12.1)

MICROSTRUCTURE

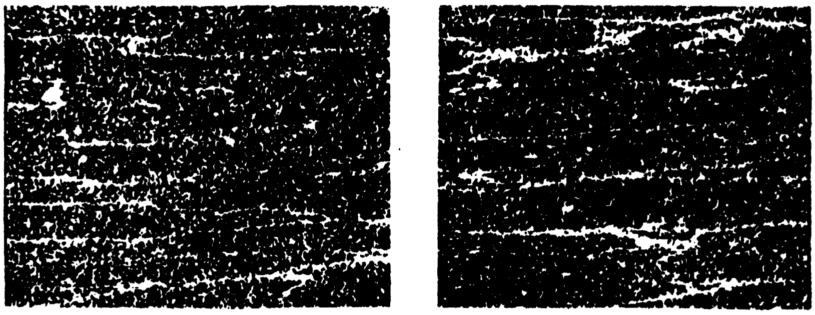
(For Reference Only)

DESIRABLE ACCEPTABLE

Up to and including 50 mm



Over 50 mm up to and including 125 mm



Over 125 mm

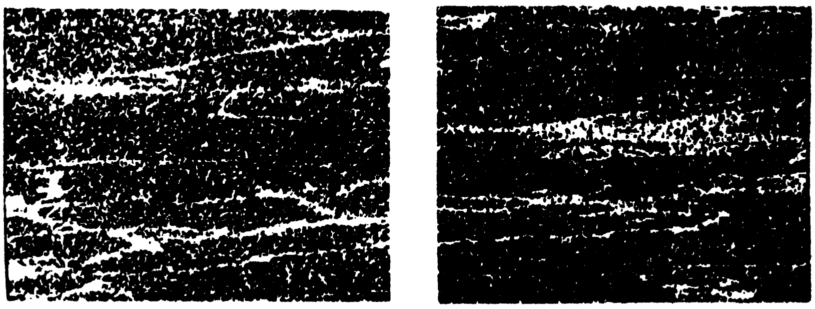
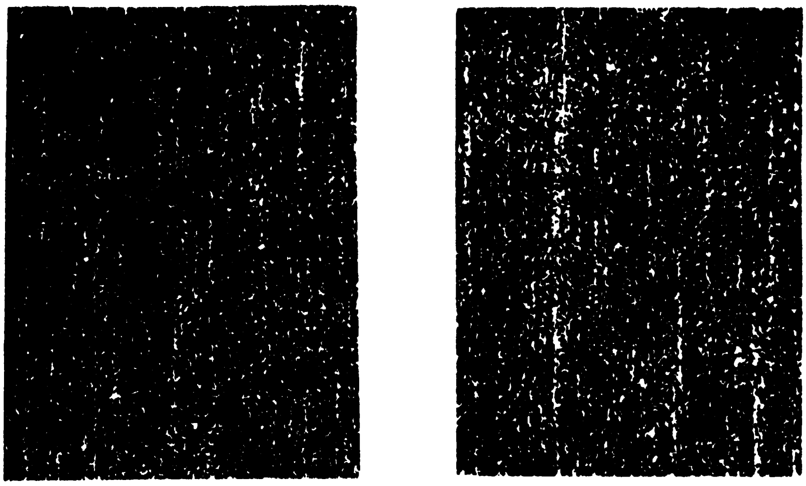


FIG. 1 CARBIDE FORM AND DISTRIBUTION STANDARDS FOR TOOL STEEL ROUND (MAGNIFICATION 100×)

DESIRABLE **ACCEPTABLE**

Up to and including 25 × 75 mm



Over 25 × 75 mm up to and including 25 × 125 mm

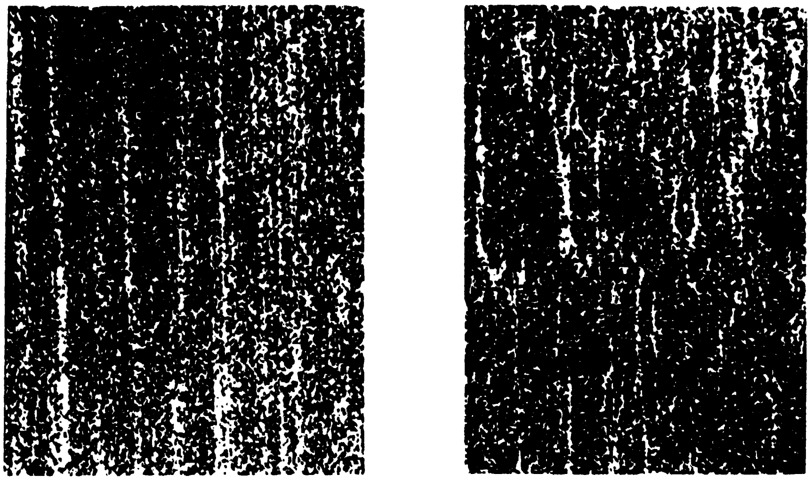


FIG. 2 CARBIDE FORM AND DISTRIBUTION STANDARDS FOR TOOL STEEL FLATS (MAGNIFICATION 100 ×)

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